

FRIULAIR[®]



COOLING SOLUTIONS FOR LASER CUTTING APPLICATIONS

Precision cooling for stable processes, consistent quality, and maximum uptime.



LASER CUTTING AS A THERMALLY SENSITIVE PROCESS

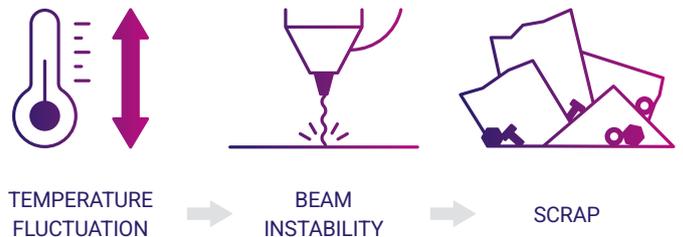
Laser cutting is a high-precision industrial process where thermal stability directly affects cutting quality, repeatability, and machine uptime.

As laser systems reach higher power levels and tighter tolerances, temperature control becomes a critical process requirement, not a secondary utility. Laser cutting performance depends on the ability to maintain stable thermal conditions throughout the entire process.

Even small temperature fluctuations can impact:

- Beam quality and focal stability
- Dimensional accuracy and edge finish
- Repeatability over long production runs
- Recalibration frequency and machine downtime

In high-precision environments, thermal instability quickly translates into scrap, rework, and reduced productivity.



THERMAL CHALLENGES IN THE LASER CUTTING PROCESS

Laser cutting machines operate under complex thermal conditions that make it difficult to maintain consistent stability and precision. Each component of the system exhibits a different thermal behavior, requiring targeted and dedicated control:

Laser Source (Resonator):

Characterized by a **sensitive and variable thermal load**, influenced by working cycles and rapid power fluctuations.

Even minimal thermal drift can affect beam stability over time.

Auxiliary Systems And Machine Components:

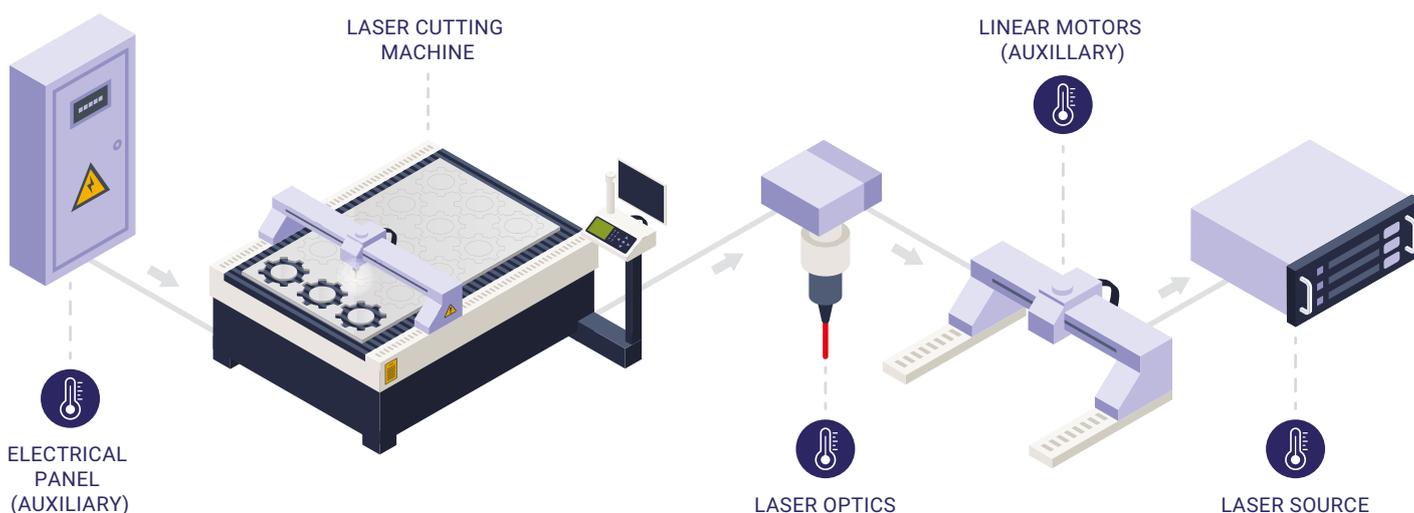
These supporting functions rely on **stable operating conditions** to prevent disturbances in the production process and to maintain the mechanical precision of the machine.

Optics And Cutting Head:

Subject to a **highly dynamic thermal load**, with rapid and irregular temperature variations during operation.

Since optical components must operate at temperatures **higher than the chiller setpoint** (typically around 30 °C) to avoid condensation, they require extremely precise thermal management.

Given this heterogeneity of thermal loads, any generic or uniform cooling approach is insufficient to manage these behaviors effectively. Thermal management is therefore one of the key challenges in the laser cutting industry.





CONNECTING INDUSTRY CHALLENGES TO CONCRETE THERMAL SOLUTIONS

Laser cutting machines operate under multiple independent thermal loads, each requiring a precise response. Friulair technology **directly addresses the critical thermal challenges** in the laser cutting process.

THERMAL DRIFT IN THE LASER SOURCE

Laser sources experience **variable thermal loads**, where even minor temperature fluctuations can affect beam stability over time.

FRIULAIR SOLUTION:

A dedicated circuit with an **electronic hot gas bypass valve** ensures $\pm 0.5\text{ }^{\circ}\text{C}$ precision on the laser source.

WHAT THIS SOLVES:

- Reduces thermal drift
- Maintains beam quality during long production runs
- Decreases recalibration frequency

RAPID, IRREGULAR THERMAL LOAD VARIATIONS ON OPTICS & CUTTING HEAD

Optical components run **above the chiller setpoint (typically $\sim 30\text{ }^{\circ}\text{C}$)** to avoid condensation, while being exposed to fast power swings during operation.

FRIULAIR SOLUTION:

A fully independent circuit with a **modulating 3 way valve** delivers **$\pm 1\text{ }^{\circ}\text{C}$ precision** and fast adaptation to dynamic optical loads.

WHAT THIS SOLVES:

- Prevents condensation on sensitive optics
- Improves focal stability
- Ensures dimensional accuracy and edge consistency

GENERIC COOLING

FRIULAIR DUAL CIRCUIT COOLING

Single circuit feeding both
Optics and Laser Source



Clear separation: Circuit A (Laser source),
Circuit B (Optics)



SLOW
RESPONSE



INTERFERENCE



CONDENSATION
RISK



FAST
REACTION



THERMAL
STABILITY



INDEPENDENT
CONTROL

**AUXILIARY COMPONENTS
REQUIRE STABLE
THERMAL CONDITIONS**

Supporting functions depend on predictable water temperature to maintain the mechanical precision of the machine.

**LASER MACHINES DEMAND
INDUSTRIAL-GRADE
CONTINUOUS DUTY**

Generic or HVAC-derived chillers cannot manage fast fluctuations and independent loads.

**RAPID RESPONSE NEEDED DURING
POWER FLUCTUATIONS**

During cutting, the thermal load changes instantaneously.

FRIULAIR SOLUTION:

A dedicated auxiliary cooling loop ensures:

- Temperature stability avoiding disturbances originating from optics or source loads
- Independent control that prevents cross-interference

24/7 industrial process cooling, engineered specifically for laser machines, ensures stable control under rapidly changing loads.

A dual-circuit architecture isolates the two thermal domains, allowing each to respond independently and without disturbance.

WHAT THIS SOLVES:

- Eliminates thermal interference
- Enhances system repeatability
- Supports continuous operation

- Fewer thermal trips
- More predictable machine behavior
- Increased system lifetime

- No cross-interference between source and optics
- Stable cutting quality during dynamic cycles

FRIULAIR TECHNOLOGY OVERVIEW

Modern laser cutting machines require a cooling system capable of delivering **independent, precise, and fast reacting thermal control**. Friulair's architecture is engineered to support this complexity through:

Independent Cooling Of The Two Critical Thermal Loads

Laser sources and optics behave differently from a thermal perspective. Separating their cooling circuits ensures stable operation regardless of load asymmetry.

Targeted Hydraulics For Each Domain

Hydraulic circuits are designed to match the physical behavior of each load:

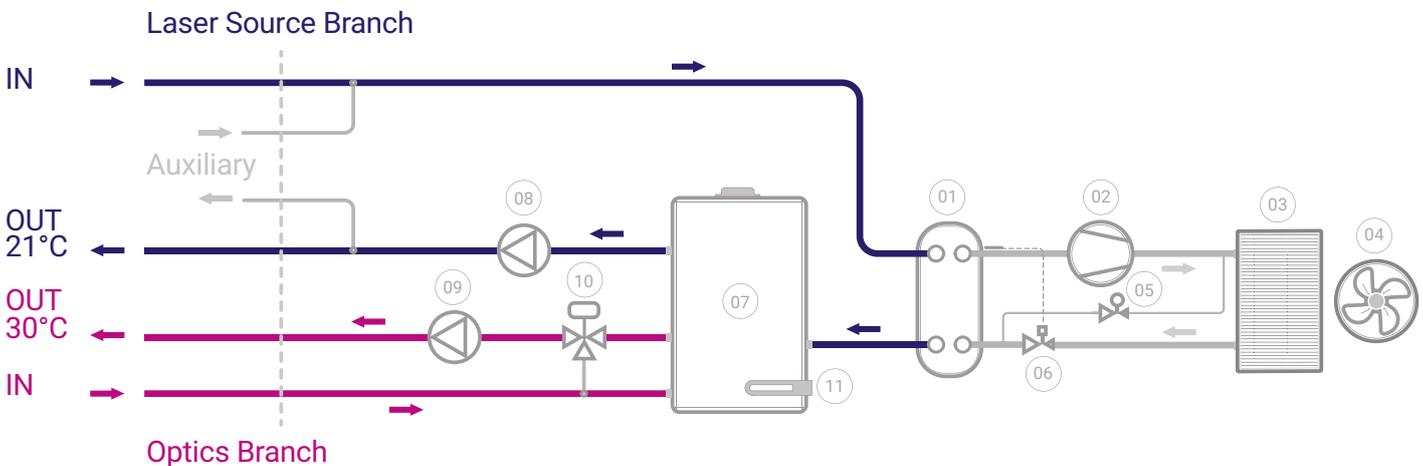
- Optics → low flow, high pressure
- Source → higher flows for greater thermal inertia

Dew Point Safety For Optical Assemblies

Optics operate safely above dew point conditions ($\approx 30\text{ }^{\circ}\text{C}$ operation), preventing condensation risks on diodes and lenses.

Process-Grade Reliability For 24/7 Operation

All components, from pumps to controls, are selected for continuous industrial duty, offering stable performance under variable loads.



- | | |
|-------------------------------------|---------------------------|
| 01 Stainless steel plate evaporator | 07 PVC atmospheric tank |
| 02 Scroll Compressor | 08 Laser pump |
| 03 Aluminum Microchannel Condenser | 09 Optics pump |
| 04 Fans | 10 Motorized 3-way valve |
| 05 Electronic hot-gas bypass valve | 11 Pre-heating resistance |
| 06 Thermostatic expansion valve | |

QBE TOTEM: DUAL-CIRCUIT LASER-DEDICATED CHILLER

Purpose built to meet the demanding thermal behavior of laser cutting systems.

Architecture & Hydraulics

- Two fully independent circuits (A = source / B = optics) with separate setpoints
- Dedicated pumps:
 - Optics → low flow / high head (5–6 bar)
 - Source → high flow suitable for demanding OEM requirements

Control & Stability

- Electronic hot gas bypass (step by step) for ± 0.5 °C precision on the source
- Modulating 3 way valve on optics for ± 1 °C under dynamic loads
- “Chiller Ready” logic preventing laser startup if the water temperature is too low
- Proprietary controller engineered for laser applications
- Integrated web server: remote monitoring, service access, and PLC mirroring

Maintenance-Friendly Features

- Easy Pump Priming function avoids trapped air and reduces startup errors
- Accessible architecture for reduced maintenance time





MONITORING, CONTROL & SYSTEM RELIABILITY

QBE TOTEM Integrates Seamlessly Into Laser Cutting Systems:

- Full interface with the machine's PLC and control architecture
- Continuous monitoring of temperatures and operating parameters
- Alarm management and built in protection functions
- Easy service access (including via remote web server) to reduce MTTR and on site in-terventions

Ensures **predictable operation with minimal operator intervention.**



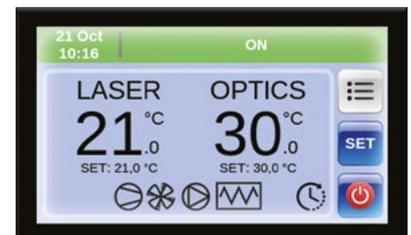
CLOUD ACCESS



TEMPERATURE TRENDS

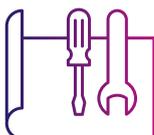


ALARMS



A LONG-TERM TECHNICAL PARTNER

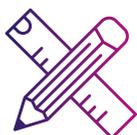
Friulair supports laser cutting operators throughout the entire lifecycle of their cooling systems, from design to long-term operation.



Technical Selection Support

- Application-driven unit sizing and configuration
- Selection aligned with process conditions and site constraints

What this means for your plant: Fewer design assumptions, correct sizing from day one, and smoother commissioning.



Customised System Configurations

- Options and accessories tailored to laser cutting environments
- Solutions adapted for variable thermal loads and plant layouts

What this means for your plant: A solution that fits your process, not a standard unit forced into a complex application.



Spare Parts And Service Network

- Availability of original spare parts
- Access to trained service partners

What this means for your plant: Faster interventions, reduced downtime, and long-term system reliability.



With Friulair service support, cooling systems remain reliable over time, protecting plant availability and reducing operational risk.



COMPLIANCE & REGULATORY ROADMAP

Friulair is committed to full compliance with current and upcoming industry standards, ensuring long-term safety, efficiency, and regulatory alignment for all laser-dedicated cooling systems.



Refrigerants

TRANSITION TO R513A

All units above 12 kW are transitioning to the low-GWP refrigerant **R513A**, suitable for indoor installation without additional safety assessments.



ERP

ECODESIGN 2026

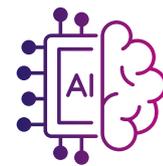
Our designs are already **ERP-ready**, incorporating high-efficiency motors and compliant fan technologies to meet the 2026 Ecodesign requirements.



Industry 4.0

CONNECTIVITY

Friulair chillers offer full **Industry 4.0-ready** digital integration, including data read/write capabilities, remote supervision, and seamless interfacing with factory automation systems.



Industry 5.0

FRAMEWORK

Energy-performance validation within the **Industry 5.0** model is conducted directly on the customer's system through certified measurements, ensuring accurate, application-specific assessment.



FRIULAIR – YOUR PARTNER FOR INDUSTRIAL COOLING IN LASER APPLICATIONS

With decades of experience in **industrial cooling** and **process temperature control**, Friulair develops dedicated solutions for precision manufacturing industries worldwide. By combining **application expertise**, robust engineering, and long term support, Friulair turns thermal control into a **strategic advantage** for laser cutting systems. **Contact Friulair** to design a reliable, efficient cooling solution tailored to your laser application.

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